(No Model.)

F. M. BOOKWALTER.

WATER WHEEL.

No. 509,863. Patented Dec. 5, 1893.

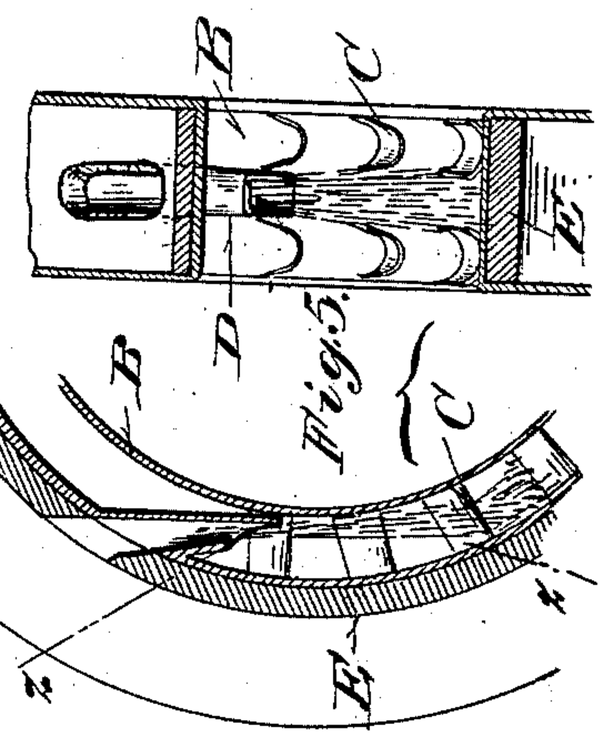

Fig. 5.

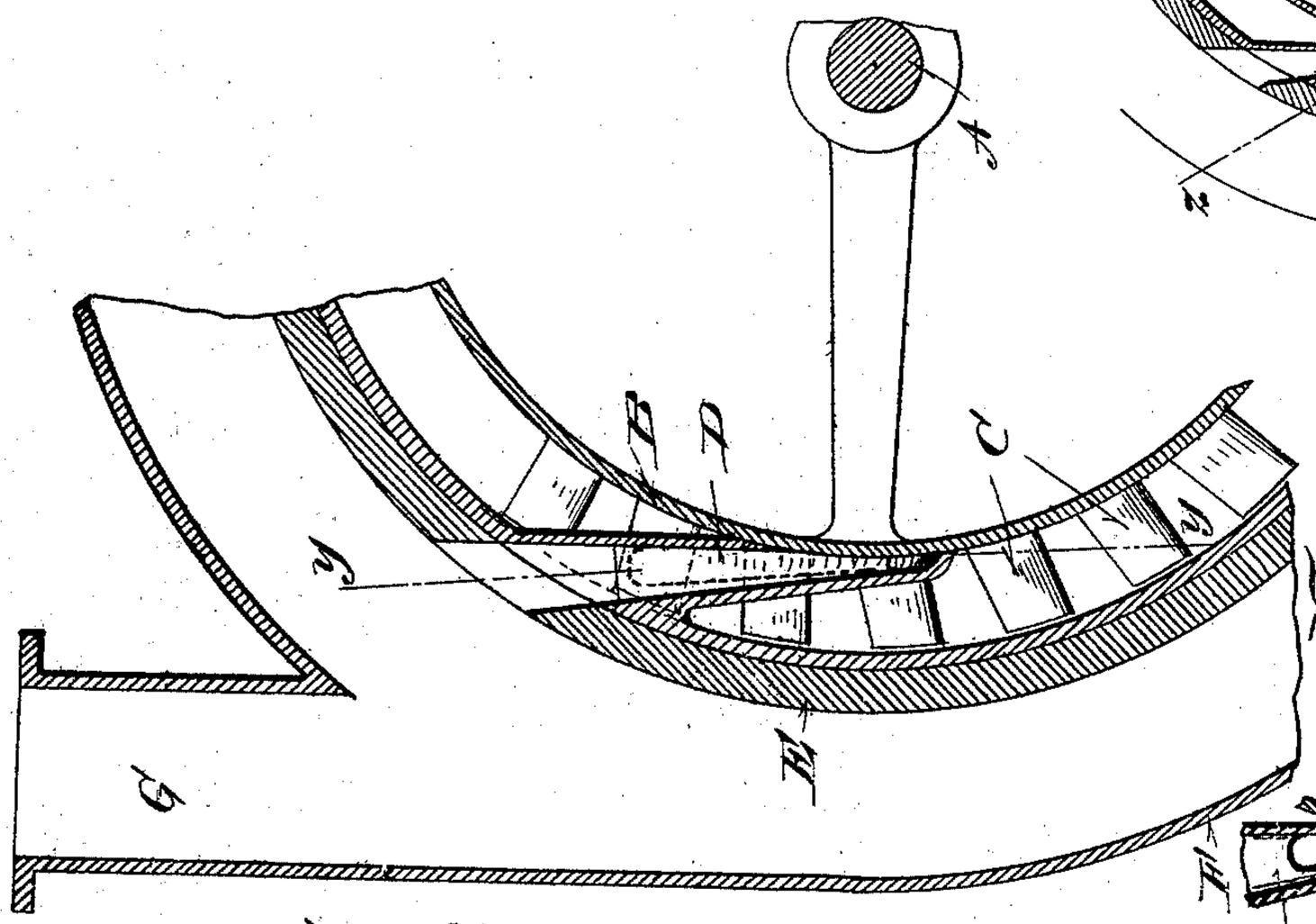

Fig. 1.

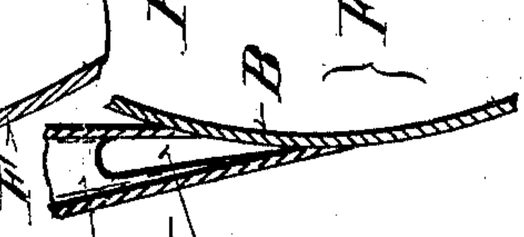

Fig. 2.

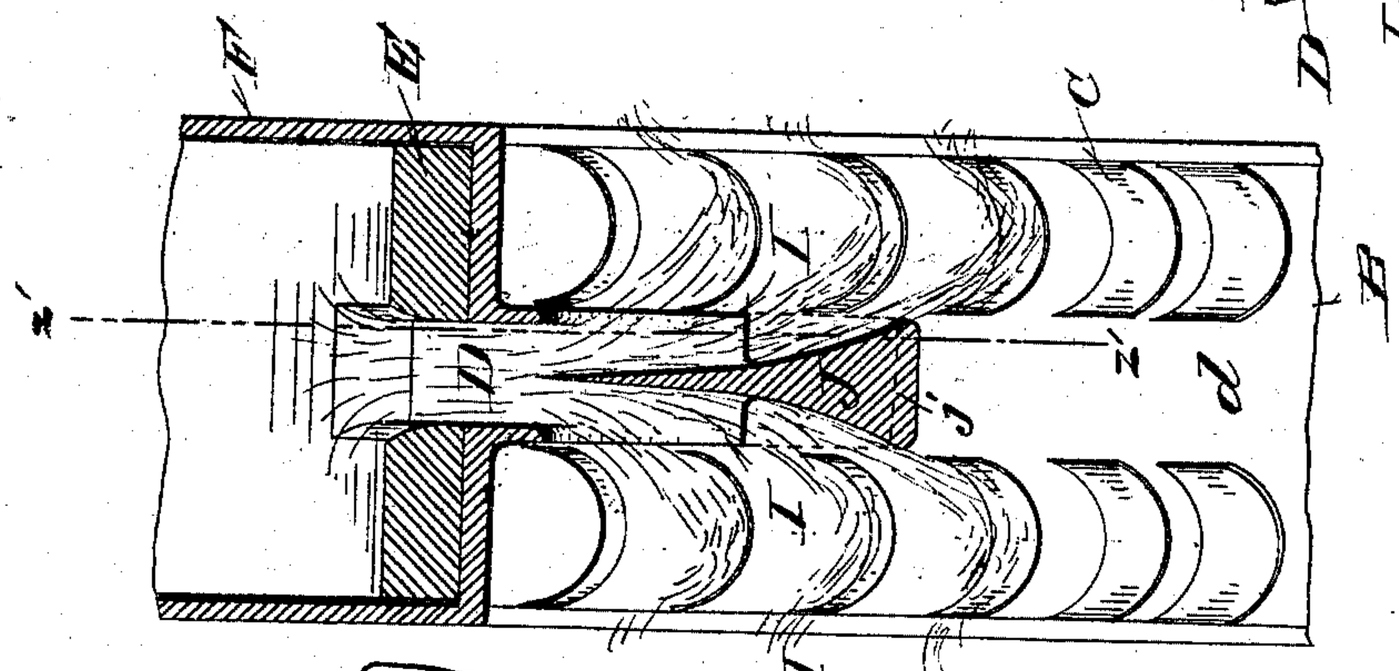

Fig. 3.

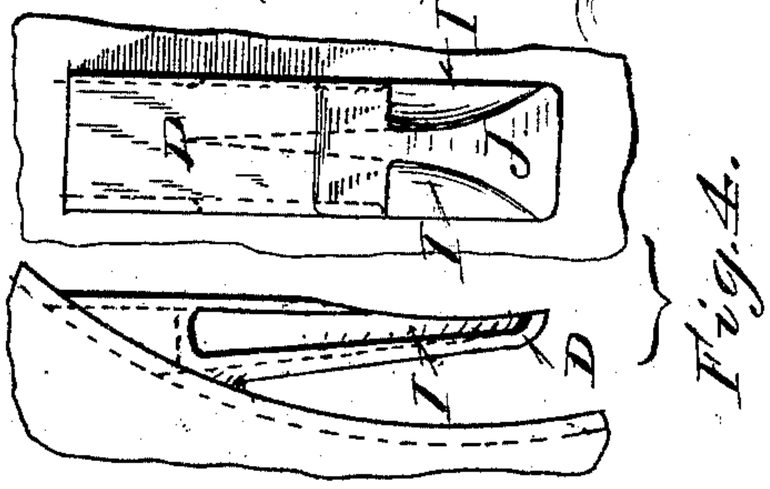

Fig. 4.

WITNESSES:

H. M. Plaisted

Jas. T. Dawley

INVENTOR

Francis M. Bookwalter

BY

H. A. Toulmin

HIS ATTORNEY.

THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

FRANCIS M. BOOKWALTER, OF SPRINGFIELD, OHIO.

WATER-WHEEL.

SPECIFICATION forming part of Letters Patent No. 509,863, dated December 5, 1893.

Application filed January 14, 1893. Serial No. 458,399. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS M. BOOKWALTER, a citizen of the United States, residing at Springfield, in the county of Clark and State of Ohio, have invented certain new and useful Improvements in Water-Wheels, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates to certain new and useful improvements in water wheels, and relates in part to the class known as hurdy gurdy wheels, and in part to the class known as turbine wheels.

The object of my improvements is to provide a wheel adapted to run at lower speed than ordinary turbine wheels under a certain head and with the same amount of water, and have reference to a peculiar form of bucket; have reference to the delivery of the impelling stream to such buckets in such wise that while the water enters them with less than full energy due to the head, still the full energy is utilized and developed in the wheel before it leaves them; have reference to a form of nozzle adapted to deflect the propelling stream laterally into a double row of buckets on either side thereof; have reference to a wheel proper having buckets discharging laterally, and separated by an annular space in which the supply nozzle is located, the said buckets being open at their outer or peripheral sides, but being closed by the casings at said sides; and have reference to other points of detail hereinafter described and claimed.

In the accompanying drawings on which like reference letters indicate corresponding parts: Figure 1 represents a sectional view of a portion of the casing and the wheel, and the nozzle; Fig. 2, a detail sectional view of a portion of the rim of the wheel and a portion of the nozzle; Fig. 3, an edge view of a portion of the wheel with the nozzle in section on the line *y y* of Fig. 1; Fig. 4, a side and edge view of the nozzle shown in Figs. 1 and 3; and Fig. 5, another form of nozzle shown in section and in edge view with its adjacent parts of the wheel proper and casing.

The wheel belongs to the hurdy-gurdy class in part, and in part to the turbine class, and is an impulse and reaction wheel as distinguished from a pressure and reaction or turbine wheel. The speed in turbine wheels is often excessive, and it has been my aim to so construct a hurdy-gurdy type of wheel with a casing of the class belonging to turbine wheels, as to slow down the speed or number of revolutions per minute, without correspondingly decreasing the power of the wheel and its efficiency. With this end in view, I have mounted a wheel proper, on a horizontal axis A, and provided the rim B with a double series of buckets C, discharging laterally in both directions from a number of propelling streams supplied at or near the center of the rim, through nozzles D, regulated by a register gate E, mounted within a casing F, surrounding said wheel proper peripherally, and forming an annular chamber supplied by an inlet opening G. The register gate is operated by the usual operating means. (Not shown.) The buckets are mounted on the rim of the wheel proper and discharged laterally, as above mentioned, but are open at their peripheral or outer sides. The water, however, is prevented from splashing out from the peripheral side of the buckets, by a stationary wall, guiding portion or casing, past which said buckets rotate, which thus close the said sides. This inclosing wall is constituted by the inner wall of the casing F, as shown in the accompanying figures, but other stationary inclosing means may be employed for the purpose, whereby the impelling stream will be directed laterally outward and through the buckets.

In Figs. 1 and 3 the buckets are separated, axially, to constitute an annular space or channel *d* in which is located the extended nozzle D, shown in detail in Fig. 4. This form of nozzle has lateral openings *l*, and extends toward the rim so that its lower end is tangential, or nearly so, to the surface of the rim, which assists in deflecting the water laterally into the double set of buckets embracing the nozzle. A dividing ridge or wedge J is provided at said lower end of the nozzle to assist in thus deflecting the impelling stream. This wedge is clearly shown in the sectional view Fig. 3 and in Fig. 4 where the end of the nozzle, adjacent to the rim, is clearly shown in front and side views. The length of the openings *l* are of considerable extent in order

to deliver the water to two or more buckets on each side of the nozzle, as shown in Fig. 3.

Referring to Fig. 1, it will be observed that the end of the nozzle is practically closed by such tangential arrangement with regard to the rim B. The outer end of the nozzle may, however, be turned inward, as shown in this sectional view, and the dividing wedge J may be dispensed with, and the water still be delivered laterally through the openings *l* by the aid of the rim, thus closing the end of the nozzle, as is shown in Fig. 2. This dispensing with the wedge is indicated by the dotted line at *j*, in Fig. 3, indicating where the end of the nozzle turns inward toward the rim of the wheel proper, while Fig. 2 shows the outer wall straight and abutting on the rim B. While this lateral deflection of the water into the buckets may be effected by the guiding action of the rim in connection with the nozzle, whether or not the latter be supplied with the wedge J, yet such deflection may also be effected by directing the stream from the nozzle against the inner wall of the casing next to the buckets, as shown in Fig. 5, whereby the stream is splashed or turned laterally, and having no other means of outlet from the annular space between the buckets must find its way laterally into said buckets as it travels a greater or less distance around on the encircling wall of the casing. Such nozzle, indicated in Fig. 5, is preferably cut away on its outer side to allow the free discharge of the water toward the casing, and away from the rim instead of toward the rim, as previously described.

The inner portion of the curve of the buckets, as seen in Figs. 3 and 5, is the feature by which the speed of the wheel is reduced to that required, to prevent undue destruction and to adapt the wheel to excessively high heads. It will be understood that turbine wheels run at such high speed that in practice they cannot be used in very high heads, say heads from four hundred feet upward. I therefore provide this wheel with the curved form of bucket shown, so that the inner portion of each bucket curves up to and toward the place where the water enters it, preventing the water from having too positive an impulse effect on it, thus slowing or reducing the speed of the wheel.

In an application for Letters Patent, Serial No. 477,586, filed by me June 14, 1893, I have described, claimed and shown the peculiar contour of buckets likewise described, shown and claimed in this application, but in combination with a water dividing instrumentality or ridge, as distinguised from a construction wherein the water dividing edge is a part of the buckets, as in this application.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a water wheel, the combination with an inclosing casing constructed to encircle only the periphery of the wheel proper, a nozzle located substantially midway the width or breast of said casing and extending from the casing inward toward the wheel, of the wheel proper and buckets carried by the periphery of the wheel, the buckets being open at their outer sides and in effect closed at their peripheries by the casing, and being arranged in a series at either side of the nozzle, the latter occupying a position within the peripheries of the buckets and between their inner sides.

2. In a water wheel, the combination with a wheel proper, having lateral discharge buckets separated at their inner entering edges to constitute an annular channel, of one or more nozzles extending into said channel and each having its inner end in immediate proximity to the rim of the said wheel proper, and provided with lateral discharge openings or slots on either side of a dividing wedge extending up within said nozzle, whereby the water is deflected outward laterally into said buckets.

3. In a water wheel, the combination with a wheel proper having lateral discharge buckets arranged in a double series thereon, and separated to constitute an annular space or channel between their inner entering edges, of nozzles mounted in said annular space or channel, provided with lateral discharge openings, and having their lower ends adjacent to and closed by the rim of the wheel proper, substantially as shown and described.

4. In a water wheel, the combination with an inclosing casing constructed to encircle the periphery of the wheel proper, a water opening in the casing and a nozzle extending inward therefrom to near the periphery of the wheel, of the wheel proper having buckets on its periphery, the buckets being in a double series with an annular space between them for the accommodation of the nozzle, and each bucket having a sharp water entering edge, with its wall turning at its inner portion toward and up to the said water entering edge, all substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

FRANCIS M. BOOKWALTER.

Witnesses:
AL. H. KUNKLE,
H. M. PLAISTED.